

z/OS  
Version 2 Release 4

*Getting Started  
with XL C/C++ V2.4.1 for z/OS V2.4*



**Note**

Before using this information and the product it supports, read the information in [“Notices” on page 9.](#)

This edition applies to Version 2 Release 4 Modification 1 of XL C/C++ for IBM® z/OS® (5650-ZOS) and to all subsequent releases and modifications until otherwise indicated in new editions.

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# Chapter 1. About this document

This information supports IBM z/OS XL C/C++ (5650-ZOS) and contains information about IBM XL C/C++ V2.4.1 for z/OS V2.4.

**Note:** This publication refers to IBM XL C/C++ V2.4.1 for z/OS V2.4 as XL C/C++ V2.4.1.

This information is primarily intended as a quick start guide for the XL C/C++ V2.4.1 compiler. It provides information about the compiler overview and how to compile applications written in C and C++.

## Softcopy documents

The XL C/C++ V2.4.1 publications are supplied in PDF format and available for download from the [z/OS XL C/C++ documentation library](https://www.ibm.com/support/pages/zos-xl-cc-documentation-library) (<https://www.ibm.com/support/pages/zos-xl-cc-documentation-library>).

To read a PDF file, use the Adobe Reader. If you do not have the Adobe Reader, you can download it (subject to Adobe license terms) from the [Adobe website](http://www.adobe.com) ([www.adobe.com](http://www.adobe.com)).

## Technical support

Additional technical support is available at the [z/OS XL C/C++ Support page](http://www.ibm.com/mysupport/s/topic/0TO0z0000006v6TGAQ/xl-cc) ([www.ibm.com/mysupport/s/topic/0TO0z0000006v6TGAQ/xl-cc](http://www.ibm.com/mysupport/s/topic/0TO0z0000006v6TGAQ/xl-cc)). This page provides a portal with search capabilities to a large selection of technical support FAQs and other support documents.

For the latest information about z/OS XL C/C++, visit the [product page for z/OS XL C/C++](#).

For information about boosting performance, productivity and portability, visit [IBM Z and LinuxONE Community](#).

If you cannot find what you need, you can e-mail: [compinfo@cn.ibm.com](mailto:compinfo@cn.ibm.com)



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## Chapter 2. Overview of XL C/C++ V2.4.1

XL C/C++ V2.4.1 provides C and C++ compilers that adopt the Clang infrastructure from the LLVM open source community for a portion of the compilers. These compilers add support for the core C11 standard and most of the C++11 and C++14 standards alongside the language standards supported in the XL C/C++ V2.4.1 compiler for easier application migration to IBM Z.

XL C/C++ V2.4.1 is designed to aid in porting code from other platforms and to give a more familiar view to those who are accustomed to a UNIX environment. As such, the compilers are supported on z/OS UNIX Systems Services only. They support EBCDIC and ASCII execution character sets and generate AMODE 64 code. They can be invoked in a z/OS UNIX shell session or OMVS session. The invocation utility, configuration file, and system header files are all located in z/OS UNIX. For more information about utilities and binder, refer to [z/OS XL C/C++ User's Guide, V2.4 \(https://www.ibm.com/support/knowledgecenter/en/SSLTBW\\_2.4.0/com.ibm.zos.v2r4.cbcux01/abstract.htm\)](https://www.ibm.com/support/knowledgecenter/en/SSLTBW_2.4.0/com.ibm.zos.v2r4.cbcux01/abstract.htm).

The code generated by XL C/C++ V2.4.1 is Language Environment® based, using 64-bit addressing and XPLINK linkage. This allows mixing C and C++ code easily while providing the performance benefits of XPLINK.

XL C/C++ V2.4.1 and the new C++ library provides support for the core C11 standard and most of the C++11 and C++14 standard along with a number of commonly used extensions. You can modernize your C and C++ development on z/OS for improved platform performance with C11, C++11, and C++14 language standard features.

**Note:** The C++ library in the C++11 language standard is not binary compatible with the previous C++ language standards. Objects compiled with z/OS XL C/C++ V2.4 and previous releases are not compatible with objects generated by XL C/C++ V2.4.1. Although the breakage requires additional migration effort, the XL C/C++ V2.4.1 compiler can be used to modernize the C++ implementation in applications.



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## Chapter 3. Downloading and installing XL C/C++ V2.4.1

XL C/C++ V2.4.1 is for clients that have enabled the z/OS XL C/C++ compiler (an optionally priced feature) on z/OS V2.4 only. It coexists with and does not replace the base XL C/C++ V2.4 compiler. The XL C/C++ V2.4 and V2.4.1 compilers are both designed to be used independently and are also serviced and supported independently.

### Downloading XL C/C++ V2.4.1

XL C/C++ V2.4.1 is a web deliverable that can be downloaded at [z/OS Downloads website \(http://www.ibm.com/systems/z/os/zos/downloads/\)](http://www.ibm.com/systems/z/os/zos/downloads/).

### Installing XL C/C++ V2.4.1

Program Directory for XL C/C++ V2R4M1 web deliverable for z/OS (<http://publibfp.dhe.ibm.com/epubs/pdf/i1357010.pdf>) is intended for the system programmers who are responsible for program installation and maintenance. It contains information about the material and procedures associated with the installation of XL C/C++ V2.4.1.



## Chapter 4. Compiling using XL C/C++ V2.4.1

The XL C/C++ V2.4.1 compiler introduces two new invocation commands, **xlclang** and **xlclang++**, to invoke the new Clang-based compilers for your C and C++ source code. You can compile with any supported compiler options that are needed.

To ease your migration, most IBM z/OS XL C/C++ compiler options that are available in the z/OS XL C/C++ V2.4 compiler, including the **-q** options and flag options, are selectively supported by XL C/C++ V2.4.1. In addition, some GCC or Clang options are supported by XL C/C++ V2.4.1 as well, which means fewer migration effort is needed when you migrate your GCC or Clang programs to XL C/C++ V2.4.1. You are encouraged to use GCC or Clang options instead of equivalent z/OS XL C/C++ V2.4 compiler options with the XL C/C++ V2.4.1 compiler wherever possible.

Some of the IBM pragmas that are supported in z/OS XL C/C++ V2.4 and previous releases are not supported in XL C/C++ V2.4.1. If you want to compile with XL C/C++ V2.4.1, you need to modify your programs that were previously written for and compiled with z/OS XL C/C++ V2.4 or earlier releases.

### Examples

The following source code examples show C and C++ source code files and the typical invocation commands used to compile them.

#### Example 1: Main program (C): `validateArguments.c`

```
#include <stdlib.h>

int lookupTable[11];

int getRC(int factor1, int factor2);

int main(int argc, char* argv[]) {
    // Validate the argument count
    if (argc < 3) {
        return 1;
    }
    if (argc > 3) {
        return 2;
    }

    // Initialize the global data
    for (int i = 0; i < 11; i++) {
        lookupTable[i] = i;
    }

    // Convert the arguments to numbers
    // Note: argv[0] is the executable name
    int factor1 = atoi(argv[1]);
    int factor2 = atoi(argv[2]);
    return getRC(factor1, factor2);
}
```

The source can be compiled as follows:

```
xlclang -c -Wall -qdebug validateArguments.c
```

The **xlclang** invocation command here is compiling the C source code. The **-Wall** argument (option) to the compiler instructs it to warn of possible code issues. Note that this option uses a different form of option specification than the z/OS XL C/C++ V2.4 compiler. The **-qdebug** option instructs the compiler to generate debugging information for the compiled module. This option uses the same form as the z/OS XL C/C++ V2.4 compiler. The XL C/C++ V2.4.1 compiler generally accepts options of both forms.

#### Example 2: Linked function (C++): `intMap.C`

```
extern int lookupTable[11];

extern "C" {
```

```

    int getRC(int index1, int index2);
}

int getRC(int index1, int index2) {
    for (int i : lookupTable) {
        if (i == index1) {
            return lookupTable[i] * lookupTable[index2];
        }
    }
    return -1;
}

```

The source can be compiled with the **xlclang++** invocation command as follows:

```
xlclang++ -c -Wall -qdebug intMap.C
```

Generally you should use the **xlclang++** invocation command when compiling C++ code. This allows binding to the C++ library, if it was used, as specified in the invocation stanza in the compiler configuration file. If you need to use **xlclang++** to compile source code with the `.c` suffix, you need to specify the **-+** option so that all C source files are to be recognized as C++ source files. An example is as follows:

```
xlclang++ -c -Wall -qdebug -+ validateArguments.c
```

You can then link using **xlclang++** as follows:

```
xlclang++ validateArguments.o intMap.o -o myMultiply
```

The **xlclang++** invocation command binds (or links) the two object files, `validateArguments.o` (C based) and `intMap.o` (C++ based), into a single executable file `myMultiply`, which can be invoked as follows:

```
myMultiply 9 5
```

You can use the command **echo \$?** to view the return code of `myMultiply`, which is 45.

For detailed information about compiling and linking applications using the XL C/C++ V2.4.1 compiler, see *Compiler Reference for XL C/C++ V2.4.1 for z/OS V2.4*.

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## Standards

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The following standards are supported:

- The C language is consistent with *Programming languages - C ISO/IEC 9899:1999 (C99)* and a subset of *Programming languages - C ISO/IEC 9899:2011 (C11)*. For more information, see [International Organization for Standardization \(ISO\) \(www.iso.org\)](http://www.iso.org).
- The C++ language is consistent with *Programming languages - C++ ISO/IEC 14882:1998 (C++98)*, *Programming languages - C++ ISO/IEC 14882:2003(E) (C++03)*, a subset of *Programming languages - C++ ISO/IEC 14882:2011 (C++11)*, and a subset of *Programming languages - C++ (ISO/IEC 14882:2014) (C++14)*.

The following standards are supported in combination with the z/OS UNIX System Services element:

- A subset of *IEEE Std. 1003.1-2001 (Single UNIX Specification, Version 3)*. For more information, see [IEEE \(www.ieee.org\)](http://www.ieee.org).
- *IEEE Std 1003.1—1990, IEEE Standard Information Technology—Portable Operating System Interface (POSIX)—Part 1: System Application Program Interface (API) [C language]*, copyright 1990 by the Institute of Electrical and Electronic Engineers, Inc.
- The core features of *IEEE P1003.1a Draft 6 July 1991, Draft Revision to Information Technology—Portable Operating System Interface (POSIX), Part 1: System Application Program Interface (API) [C Language]*, copyright 1992 by the Institute of Electrical and Electronic Engineers, Inc.
- *IEEE Std 1003.2—1992, IEEE Standard Information Technology—Portable Operating System Interface (POSIX)—Part 2: Shells and Utilities*, copyright 1990 by the Institute of Electrical and Electronic Engineers, Inc.
- The core features of *IEEE Std P1003.4a/D6—1992, IEEE Draft Standard Information Technology—Portable Operating System Interface (POSIX)—Part 1: System Application Program Interface (API)—Amendment 2: Threads Extension [C language]*, copyright 1990 by the Institute of Electrical and Electronic Engineers, Inc.
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- *X/Open CAE Specification, Networking Services, Issue 4*, copyright 1994 by The Open Group
- United States Government's *Federal Information Processing Standard (FIPS) publication for the programming language C, FIPS-160*, issued by National Institute of Standards and Technology, 1991





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